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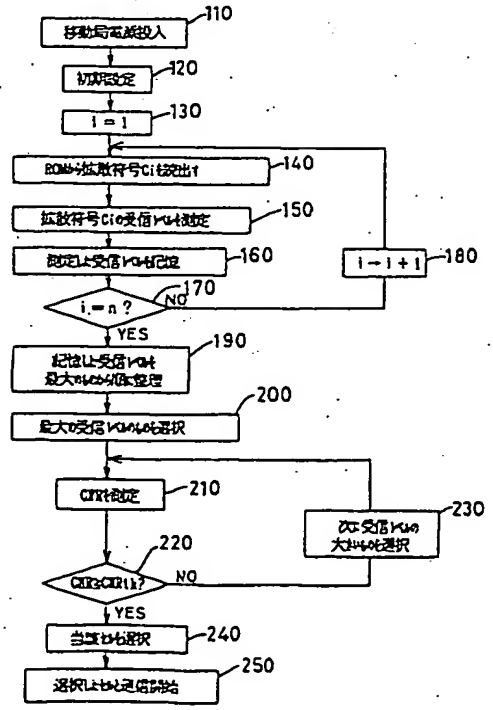
(54)【発明の名称】　移動通信セル判定方法および移動局装置と基地局装置

(57)【要約】

【目的】　受信レベルのみでなく、キャリア対雑音比も考慮して、通信品質の良好なセルを選択し得る移動通信セル判定方法および移動局装置と基地局装置を提供する。

【構成】　移動局は通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルの受信レベルを順次測定し（ステップ１５０）、この受信レベルの大きい止まり木チャネルから順にキャリア対雑音比を測定し（ステップ２１０）、このキャリア対雑音比ＣＮＲを所定のしきい値ＣＮＲthと比較し（ステップ２２０）、ＣＮＲが所定のしきい値ＣＮＲthより大きいセルを選択する（ステップ２４０）。



【特許請求の範囲】

【請求項１】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定する移動通信セル判定方法であって、
移動局は通信すべきセル候補に割り当てられた拡散符号を保持し、
この保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定し、
この測定した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を測定し、
この測定したキャリア対雑音比が所定のしきい値より大きいセルを選択することを特徴とする移動通信セル判定方法。

【請求項２】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定する移動通信セル判定方法であって、
移動局は通信すべきセル候補に割り当てられた拡散符号を保持し、
この保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定し、
この測定した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定し、
この測定したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択することを特徴とする移動通信セル判定方法。

【請求項３】　移動局が保持している前記セル候補の拡散符号は、すべてのセルの拡散符号として移動局に予め記憶されているものであることを特徴とする請求項１または２記載の移動通信セル判定方法。

【請求項４】　移動局が保持している前記セル候補の拡散符号は、移動局が通信中のセルの基地局から受信したものであることを特徴とする請求項１または２記載の移動通信セル判定方法。

【請求項５】　前記セルを選択した後、移動局は該セルと通信を開始することを特徴とする請求項１または２記載の移動通信セル判定方法。

【請求項６】　移動局は前記選択されたセルの基地局に対して該セルを選択したことを通知し、この通知されたセルの基地局は通信チャネルを介して前記移動局と通信を開始することを特徴とする請求項１または２記載の移動通信セル判定方法。

【請求項７】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいてセル判定を行う移動局装置であって、
通信すべきセル候補に割り当てられた拡散符号を保持する拡散符号保持手段と、
該拡散符号保持手段に保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定する受信レベル測定手段と、
該受信レベル測定手段で測定した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を測定するキャリア対雑音比測定手段と、
この測定したキャリア対雑音比が所定のしきい値より大きいセルを選択するセル選択手段とを有することを特徴とする移動局装置。

【請求項８】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいてセル判定を行う移動局装置であって、
通信すべきセル候補に割り当てられた拡散符号を保持する拡散符号保持手段と、
該拡散符号保持手段に保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定する受信レベル測定手段と、
該受信レベル測定手段で測定した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定するキャリア対雑音比測定手段と、
この測定したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択するセル選択手段とを有することを特徴とする移動局装置。

【請求項９】　前記拡散符号保持手段は、すべてのセルに割り当てられた拡散符号を予め記憶されている拡散符号記憶手段を有することを特徴とする請求項７または８記載の移動局装置。

【請求項１０】　前記拡散符号保持手段は、通信中のセルの基地局からセル候補の拡散符号を受信して保持する拡散符号受信手段を有することを特徴とする請求項７または８記載の移動局装置。

【請求項１１】　前記セル選択手段で選択されたセルの基地局と通信開始する通信開始手段を有することを特徴とする請求項７または８記載の移動局装置。

【請求項１２】　前記セル選択手段で選択されたセルの基地局に対して該セルを選択したことを通知する通知手

段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始することを特徴とする請求項７または８記載の移動局装置。

【請求項１３】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局と通信中において移動局が通信すべきセルを判定するセル判定を行う基地局装置であって、

移動局に保持され、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルを移動局に順次受信せしめて、その受信レベルを測定させ、その測定結果を基地局に送信させ、この送信された測定結果を受信する受信レベル受信手段と、

該受信レベル受信手段で受信した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定されたキャリア対雑音比を基地局に送信させ、この送信されたキャリア対雑音比を受信するキャリア対雑音比受信手段と、

該キャリア対雑音比受信手段で受信したキャリア対雑音比が所定のしきい値より大きいセルを選択する選択手段とを有することを特徴とする基地局装置。

【請求項１４】　複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定するセル判定を行う基地局装置であって、

移動局に保持され、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルを移動局に順次受信せしめて、その受信レベルを測定させ、その測定結果を基地局に送信させ、この送信された測定結果を受信する受信レベル受信手段と、

該受信レベル受信手段で受信した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定されたキャリア対雑音比を基地局に送信させ、この送信されたキャリア対雑音比を受信するキャリア対雑音比受信手段と、

該キャリア対雑音比受信手段で受信したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択する選択手段とを有することを特徴とする基地局装置。

【請求項１５】　前記移動局に保持され、通信すべきセル候補に割り当てられた拡散符号は移動局にすべてのセルの拡散符号として予め記憶されているものであることを特徴とする請求項１３または１４記載の基地局装置。

【請求項１６】　前記移動局に保持され、通信すべきセル候補に割り当てられた拡散符号は基地局装置から移動局に送信して保持されたものであることを特徴とする請求項１３または１４記載の基地局装置。

【請求項１７】　前記セル選択手段で選択されたセルの基地局との通信を移動局に開始させる通信開始手段を有することを特徴とする請求項１３または１４記載の基地局装置。

【請求項１８】　前記セル選択手段で選択されたセルの基地局に対して該セルを選択したことを通知する通知手段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始することを特徴とする請求項１３または１４記載の基地局装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、スペクトル拡散符号を用いた符号分割多元接続（以下、ＣＤＭＡと略称する）方式の移動通信システムに使用される移動通信セル判定方法および移動局装置と基地局装置に関し、更に詳しくは、ＣＤＭＡ方式の移動通信システムにおいて複数のセルからなるサービスエリアにおいて移動局が通信すべきセルを判定する移動通信セル判定方法および移動局装置と基地局装置に関する。

【０００２】

【従来の技術】スペクトル拡散符号を用いたＣＤＭＡ方式の移動通信システムにおいては、サービスエリアを複数の単位領域であるセルに分割するとともに、各セル内に１つの基地局を設け、サービスエリア内のあるセル内に存在する移動局は無線回線を介してそのセルの基地局と通信し、該基地局から更に他の無線回線または通信回線を介して他の移動局または電話機等と通信を行うようになっている。

【０００３】ところで、移動局は、電源投入時には、どの基地局とも通信していないものであるため、どのセル内に存在しているのか不明であり、またどのセルの基地局と通信を行ったらよいのか不明である。従って、移動局は、電源投入時には、自分が存在しているセルはどこであるか、すなわち自分が通信できるセルの基地局はどこであるかを検出するセル判定処理を行う必要がある。

【０００４】ＣＤＭＡ方式の移動通信システムにおいて、各セルの基地局は同一周波数のそれぞれ異なる所定の拡散符号を割り当てられ、該拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している。例えば、図６に示すように、サービスエリア内に設けられている複数のセル１，２，３，・・・にはそれぞれ異なる拡散符号Ｃ１，Ｃ２，Ｃ３，・・・が割り当てられている。そして、各セルの基地局Ｂ１，Ｂ２，Ｂ３，・・・は、この割り当てられた拡散符号で拡散された止まり木チャネルを常時送信している。

【０００５】一方、各移動局Ｍ１は、上述したように各

セルに割り当てられた拡散符号Ｃ１，Ｃ２，Ｃ３，・・・をＲＯＭに記憶している。そして、例えば電源投入時にセル判定を行おうとする移動局はＲＯＭに記憶されている拡散符号を順次読み出し、この読み出した拡散符号で拡散された止まり木チャネルを順次受信し、その受信レベルを相互に比較し、該受信レベルが最も大きいセルを選択し、この選択したセルの基地局と通信を行うようになっている。

【０００６】なお、このようなセルの選択は、電源投入時だけでなく、移動局が在圏しているセルから他のセルに移動する時にも、どのセルを選択すべきかということで同様に行う必要があるものである。

【０００７】

【発明が解決しようとする課題】ところで、ＣＤＭＡ方式の移動通信方式においては、すべてのセルにおいて周波数を同一とし、この周波数を拡散符号で分割したものをキャリアとして使用しているものである。そして、各セルは、同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信し、この止まり木チャネルをセル判定用に使用するとともに、また通常の通信チャネル等も同じように拡散符号を使用しているものであり、各拡散符号は互いに無相関でなく、相互相関を有し、これが受信レベルに雑音として上乗せされている。

【０００８】このように受信レベルに上乗せされる雑音としては、詳細には、他の拡散符号からの相互相関による雑音、拡散符号は複数のセルからなる１つのクラスタ内ではすべて異なっているが、他のクラスタ外では繰り返し使用されている場合もあるので、この自己の拡散符号の繰り返し利用による雑音、そして熱雑音等が含まれる。

【０００９】図７は、例えばある拡散符号Ｃ１で周期をとろうとして相関器にかけた場合の特性を示しているが、同図（ａ）に示すように、拡散符号Ｃ１の受信レベルは斜線で示す雑音、すなわち拡散符号Ｃ１に対して他の拡散符号Ｃ２，Ｃ３，・・・等からの相互干渉による雑音等により上げ底されて増大している。

【００１０】従って、図７（ｂ）に示すように、受信レベルが同じに測定されたとしても、右側に示す受信レベルには斜線で示す雑音が左側の受信レベルよりもかなり大きく加算されているため、同じ受信レベルであるにも関わらず、この受信レベルを選択した回線の通信品質はかなり悪くなる。

【００１１】すなわち、上述した従来の方法においては、干渉レベル等の雑音も一緒に含んだ受信レベルを測定し、その受信レベルのみで選択すべきセルを判定し、相互相関等の雑音による分を無視しているため、受信レベルが大きいセルを選択したとしても、実際にはかなり大きな干渉レベル等の雑音が受信レベルに加算されており、単に受信レベルの大きさのみでセルを選択した場合には通信品質がかなり悪くなるという問題がある。

【００１２】本発明は、上記に鑑みてなされたもので、その目的とするところは、受信レベルのみでなく、キャリア対雑音比も考慮して、通信品質の良好なセルを選択し得る移動通信セル判定方法および移動局装置と基地局装置を提供することにある。

【００１３】

【課題を解決するための手段】上記目的を達成するため、本発明の移動通信セル判定方法は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定する移動通信セル判定方法であって、移動局は通信すべきセル候補に割り当てられた拡散符号を保持し、この保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定し、この測定した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を測定し、この測定したキャリア対雑音比が所定のしきい値より大きいセルを選択することを要旨とする。

【００１４】また、本発明の移動通信セル判定方法は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定する移動通信セル判定方法であって、移動局は通信すべきセル候補に割り当てられた拡散符号を保持し、この保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定し、この測定した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定し、この測定したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択することを要旨とする。

【００１５】更に、本発明の移動通信セル判定方法は、移動局が保持している前記セル候補の拡散符号がすべてのセルの拡散符号として移動局に予め記憶されているものであることを要旨とする。

【００１６】本発明の移動通信セル判定方法は、移動局が保持している前記セル候補の拡散符号が移動局が通信中のセルの基地局から受信したものであることを要旨とする。

【００１７】また、本発明の移動通信セル判定方法は、前記セルを選択した後、移動局は該セルと通信を開始することを要旨とする。

【００１８】更に、本発明の移動通信セル判定方法は、前記選択されたセルの基地局に対して該セルを選択したことを移動局が通知し、この通知されたセルの基地局は通信チャネルを介して前記移動局と通信を開始することを要旨とする。

【００１９】本発明の移動局装置は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいてセル判定を行う移動局装置であって、通信すべきセル候補に割り当てられた拡散符号を保持する拡散符号保持手段と、該拡散符号保持手段に保持されているセル候補の拡散符号を用いて止まり木チャネルを順次送信し、その受信レベルを測定する受信レベル測定手段と、該受信レベル測定手段で測定した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を測定するキャリア対雑音比測定手段と、この測定したキャリア対雑音比が所定のしきい値より大きいセルを選択するセル選択手段とを有することを要旨とする。

【００２０】また、本発明の移動局装置は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいてセル判定を行う移動局装置であって、通信すべきセル候補に割り当てられた拡散符号を保持する拡散符号保持手段と、該拡散符号保持手段に保持されているセル候補の拡散符号を用いて止まり木チャネルを順次受信し、その受信レベルを測定する受信レベル測定手段と、該受信レベル測定手段で測定した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定するキャリア対雑音比測定手段と、この測定したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択するセル選択手段とを有することを要旨とする。

【００２１】更に、本発明の移動局装置は、前記拡散符号保持手段としてすべてのセルに割り当てられた拡散符号を予め記憶されている拡散符号記憶手段を有することを要旨とする。

【００２２】本発明の移動局装置は、前記拡散符号保持手段として通信中のセルの基地局からセル候補の拡散符号を受信して保持する拡散符号受信手段を有することを要旨とする。

【００２３】また、本発明の移動局装置は、前記セル選択手段で選択されたセルの基地局と通信開始する通信開始手段を有することを要旨とする。

【００２４】更に、本発明の移動局装置は、前記セル選択手段で選択されたセルの基地局に対して該セルを選択したことを通知する通知手段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始することを要旨とする。

【００２５】本発明の基地局装置は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局と通信中において移動局が通信すべきセルを判定するセル判定を行う基地局装置であって、移動局に保持され、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルを移動局に順次受信せしめて、その受信レベルを測定させ、その測定結果を基地局に送信させ、この送信された測定結果を受信する受信レベル受信手段と、該受信レベル受信手段で受信した受信レベルのうち、受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定されたキャリア対雑音比を基地局に送信させ、この送信されたキャリア対雑音比を受信するキャリア対雑音比受信手段と、該キャリア対雑音比受信手段で受信したキャリア対雑音比が所定のしきい値より大きいセルを選択する選択手段とを有することを要旨とする。

【００２６】また、本発明の基地局装置は、複数のセルの各々に基地局が設けられ、各基地局は同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の止まり木チャネルを常時送信している符号分割多元接続方式の移動通信システムにおいて移動局が通信すべきセルを判定するセル判定を行う基地局装置であって、移動局に保持され、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルを移動局に順次受信せしめて、その受信レベルを測定させ、その測定結果を基地局に送信させ、この送信された測定結果を受信する受信レベル受信手段と、該受信レベル受信手段で受信した受信レベルのうち、受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定されたキャリア対雑音比を基地局に送信させ、この送信されたキャリア対雑音比を受信するキャリア対雑音比受信手段と、該キャリア対雑音比受信手段で受信したキャリア対雑音比を比較し、キャリア対雑音比が最大のセルを選択する選択手段とを有することを要旨とする。

【００２７】更に、本発明の基地局装置は、前記移動局に保持され、通信すべきセル候補に割り当てられた拡散符号が移動局にすべてのセルの拡散符号として予め記憶されているものであることを要旨とする。

【００２８】本発明の基地局装置は、前記移動局に保持され、通信すべきセル候補に割り当てられた拡散符号が

基地局装置から移動局に送信して保持されたものであることを要旨とする。

【００２９】また、本発明の基地局装置は、前記セル選択手段で選択されたセルの基地局との通信を移動局に開始させる通信開始手段を有することを要旨とする。

【００３０】更に、本発明の基地局装置は、前記セル選択手段で選択されたセルの基地局に対して該セルを選択したことを通知する通知手段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始することを要旨とする。

【００３１】

【作用】本発明の移動通信セル判定方法では、移動局は通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルの受信レベルを順次測定し、この受信レベルの大きい止まり木チャネルから順にキャリア対雑音比を測定し、このキャリア対雑音比が所定のしきい値より大きいセルを選択する。

【００３２】また、本発明の移動通信セル判定方法では、移動局は通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルの受信レベルを順次測定し、この受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定し、このキャリア対雑音比が最大のセルを選択する。

【００３３】更に、本発明の移動通信セル判定方法では、すべてのセルの拡散符号が移動局に予め記憶されている。

【００３４】本発明の移動通信セル判定方法では、セル候補の拡散符号は移動局が通信中のセルの基地局から受信したものである。

【００３５】また、本発明の移動通信セル判定方法では、セルを選択した後、移動局は該セルと通信を開始する。

【００３６】更に、本発明の移動通信セル判定方法では、選択したセルの基地局に対して該セルを選択したことを移動局が通知、この通知されたセルの基地局は通信チャネルを介して該移動局と通信を開始する。

【００３７】本発明の移動局装置では、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルの受信レベルを順次測定し、この受信レベルの大きい止まり木チャネルから順にキャリア対雑音比を測定し、このキャリア対雑音比が所定のしきい値より大きいセルを選択する。

【００３８】また、本発明の移動局装置では、通信すべきセル候補に割り当てられた拡散符号を用いて止まり木チャネルの受信レベルを順次測定し、この受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を測定し、このキャリア対雑音比が最大のセルを選択する。

【００３９】更に、本発明の移動局装置では、すべてのセルに割り当てられた拡散符号を予め記憶されている。

【００４０】本発明の移動局装置では、通信中のセルの基地局からセル候補の拡散符号を受信して保持する。

【００４１】また、本発明の移動局装置では、選択されたセルの基地局と通信開始する通信開始手段を有する。

【００４２】更に、本発明の移動局装置では、選択されたセルの基地局に対して該セルを選択したことを通知する通知手段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始する。

【００４３】本発明の基地局装置では、セル候補に割り当てられた拡散符号の止まり木チャネルの受信レベルを移動局に順次測定させ、その測定結果を受信し、この受信レベルの大きい止まり木チャネルから順に該止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定したキャリア対雑音比を基地局で受信し、この受信したキャリア対雑音比が所定のしきい値より大きいセルを選択する。

【００４４】また、本発明の基地局装置では、セル候補に割り当てられた拡散符号の止まり木チャネルの受信レベルを移動局に順次測定させ、その測定結果を受信し、この受信レベルが所定のしきい値よりも大きい止まり木チャネルにおけるキャリア対雑音比を移動局に測定させ、この測定したキャリア対雑音比を受信し、このキャリア対雑音比が最大のセルを選択する。

【００４５】更に、本発明の基地局装置では、移動局にすべてのセルの拡散符号が予め記憶されている。

【００４６】本発明の基地局装置では、セル候補に割り当てられた拡散符号が基地局装置から移動局に送信して保持されたものである。

【００４７】また、本発明の基地局装置では、選択されたセルの基地局との通信を移動局に開始させる。

【００４８】更に、本発明の基地局装置では、選択されたセルの基地局に対して該セルを選択したことを通知する通知手段を有し、該通知を受けた基地局は通信チャネルを介して前記移動局と通信を開始する。

【００４９】

【実施例】以下、図面を用いて本発明の実施例を説明する。図１は、本発明の一実施例に係わる移動通信セル判定方法の処理手順を示すフローチャートである。同図に示す移動通信セル判定方法は、スペクトル拡散符号を用いたＣＤＭＡ方式の移動通信システムにおいて移動局が通信すべきセルを判定するものであり、このセル判定処理は例えば移動局が電源を投入した時に必要であるとともに、また移動局が基地局と通信中において在圏しているあるセルから他のセルに移動する時にもどのセルを選択すべきかということで必要となるものである。

【００５０】本実施例の移動通信セル判定方法では、通信すべきセルを選択するのに、各セルの基地局が常時送信している止まり木チャネル、すなわち同一周波数で変調され、それぞれ異なって割り当てられた独自の拡散符号で拡散され、送信電力制御を行わない送信電力一定の

止まり木チャネルの受信レベルを測定し、この受信レベルの大きなセルという条件に加えて、図7に関連して説明したように各セルから受信した止まり木チャネルの受信レベルは相互干渉による雑音が上乗せさせて増大しているので、この相互干渉による雑音、具体的には他の拡散符号からの相互相関による雑音、自己の拡散符号の繰り返し利用による雑音、および熱雑音等を含む雑音を考慮し、この雑音とキャリアとの比、すなわちキャリア対雑音比（以下、ＣＮＲと略称する）も算出し、このＣＮＲが所定のしきい値よりも大きいセルを選択するようにしている。

【００５１】このように受信レベルに加えて、ＣＮＲも考慮することにより、例えば図７（ｂ）に示すように受信レベルが同じ左右の信号においても斜線部分で示す相互干渉による雑音の小さな左側の信号のセルが選択されることになる。すなわち、図７（ｂ）では、斜線部分で示す相互干渉による雑音の小さい左側の信号のＣＮＲの方が雑音の大きい右側の信号のＣＮＲよりも大きいので、左側の信号のセルが選択されることになる。

【００５２】図２は、図１の移動通信セル判定方法を実施する移動局１０および基地局２０の構成を示すブロック図である。移動局１０は、基地局２０と通信を行うためのアンテナ１１、該アンテナ１１に送受切替器１２を介して接続されている送信回路部１３および受信回路部１４、該送信回路部１３と受信回路部１４に接続された制御部１５、および受信回路部１４で受信した止まり木チャネルの受信レベルおよび該受信レベルに含まれる上述した相互干渉による雑音に相当する干渉レベルを測定する受信レベル・干渉レベル検出部１６を有する。前記制御部１５は、該受信レベル・干渉レベル検出部１６で検出された受信レベルおよび干渉レベルに基づいて前記ＣＮＲを算出するようになっている。

【００５３】また、前記受信レベル・干渉レベル検出部１６は、相関検出器１７、レベル検出器１８、および干渉検出器１９から構成されているが、この受信レベル・干渉レベル検出器１６においては、各セルの基地局からの止まり木チャネルをアンテナ１１および送受切替器１２を介して受信回路部１４で受信した出力信号が相関検出器１７に供給される。相関検出器１７は、制御部１５から指示された止まり木チャネルのレベル監視用拡散符号との相関検出を順次行い、相関検出器１７で得られたタイミングによって受信回路部１４の出力信号を対応レベル監視用拡散符号で逆拡散する。この逆拡散によって得られたパワースペクトラムをレベル検出器１８および干渉検出器１９に供給し、それぞれにおいて受信レベルの測定および干渉レベルの測定が行われる。そして、この得られた受信レベルおよび干渉レベルは制御部１５に供給され、制御部１５において受信レベルおよび干渉レベルからキャリア対雑音比、すなわちＣＮＲが算出される。このＣＮＲは後述する図１に示すフローチャートの処理に使用され、このＣＮＲに基づいて最適なセルが選択されることになる。

【００５４】また、図２に示す基地局２０においては、移動局１０と通信を行うアンテナ２１が接続されている基地局増幅器２６は変復調装置２７に接続され、該変復調装置２７は拡散装置２８に接続されている。また、変復調装置２７には制御バスコントロール３０、監視制御装置３１、２Ｍ／１．５Ｍインタフェース装置３２、基地局制御装置３３およびタイミング供給装置３４が接続されている。

【００５５】このように構成される基地局２０において生成された止まり木チャネル用の制御データは拡散装置２８でレベル監視用拡散符号によって拡散され、更に変復調装置２７によって搬送波信号に乗せられる。そして、変復調装置２７の変調出力信号は基地局増幅器２６によって増幅され、アンテナ２１から電波として送信される。なお、図２において、基地局２０は送信系の回路構成のみを示し、受信系の回路構成は示していないが、受信系の回路構成は通常の周知のものであるので、図示を省略している。

【００５６】次に、図１に示すフローチャートを参照して、移動通信セル判定方法の処理手段について説明する。なお、図１に示す処理は、移動局１０が電源を投入した時に、通信すべきセルを選択する処理であり、この場合、移動局１０はサービスエリア内に存在するすべてのセルの拡散符号Ｃを例えばＲＯＭ等に記憶して保持しているものである。

【００５７】図１の処理において、移動局１０の電源が投入されると（ステップ１１０）、まず初期設定が行われ（ステップ１２０）、前記ＲＯＭに記憶されている拡散符号を順次読み出すための変数であるｉを１に設定する（ステップ１３０）。そして、このｉ番目、今の場合には１番目の拡散符号Ｃｉをｒｏｍから読み出す（ステップ１４０）。そして、この拡散符号Ｃｉを用いて止まり木チャネルを受信して、その受信レベルを測定する（ステップ１５０）。具体的には、読み出した拡散符号Ｃｉで基地局からの止まり木チャネルの拡散符号を逆拡散して、その受信レベルを測定する。

【００５８】それから、この測定された受信レベルを記憶し（ステップ１６０）、前記変数ｉが所定の数ｎに等しいか否かをチェックする（ステップ１７０）。変数ｉがｎでない場合には、変数ｉをインクリメントし（ステップ１８０）、ステップ１４０に戻り、ＲＯＭに記憶されているすべての拡散符号に対して同様の処理を行う。

【００５９】ＲＯＭに記憶されているすべての拡散符号に対して上述した受信レベルの測定および記憶を終了すると、記憶した受信レベルを最大のものから順に整理し（ステップ１９０）、まず最大の受信レベルのものを選択し（ステップ２００）、この最大の受信レベルにおける前記ＣＮＲを測定する（ステップ２１０）。そして、

この測定したＣＮＲが所定のしきい値ＣＮＲthより大きいか否かをチェックする（ステップ２２０）。このチェックの結果、測定したＣＮＲが所定のしきい値ＣＮＲthよりも小さい場合には、次に受信レベルの大きいものを選択して（ステップ２３０）、ステップ２１０に戻り、同様にＣＮＲの測定を行う。

【００６０】ステップ２２０のチェックにおいて、測定したＣＮＲが所定のしきい値ＣＮＲthよりも大きい場合には、当該セルを選択し（ステップ２４０）、移動局１０はこの選択したセルと通信を開始する（ステップ２５０）。

【００６１】次に、図３に示すフローチャートを参照して、本発明の他の実施例に係わる移動通信セル判定方法の処理手順について説明する。図３に示す実施例は、移動局１０が基地局と通信中に他のセルに移動する場合に次に通信すべきセルを選択する場合のセル判定処理を示している。この場合には、移動局１０は現在通信中の基地局から近傍のセルの拡散符号を通知されるようになっているので、移動局１０は図１の実施例のようにＲＯＭに記憶されているすべての拡散符号について順次処理する必要はなく、基地局から通知された拡散符号についてのみ処理を行えばよい。

【００６２】図３に示す処理においては、まず移動局１０は通信中の基地局から近傍のセルであるｍ個のセル候補の拡散符号を受信し、メモリに記憶保持する（ステップ３１０）。そして、この記憶されている拡散符号を順次読み出すための変数であるｉを１に設定する（ステップ１３０）。そして、このｉ番目、今の場合には１番目の拡散符号Ｃｉをメモリから読み出す（ステップ１４０）。そして、この拡散符号Ｃｉを用いて止まり木チャネルを受信して、その受信レベルを測定する（ステップ１５０）。それから、この測定された受信レベルを記憶し（ステップ１６０）、前記変数ｉが所定の数ｍに等しいか否かをチェックする（ステップ１７２）。変数ｉがｍでない場合には、変数ｉをインクリメントし（ステップ１８０）、ステップ１４０に戻り、メモリに記憶されているすべての拡散符号に対して同様に処理を行う。

【００６３】上述したように、基地局から通知され、メモリに記憶保持されているすべての拡散符号について受信レベルを測定し、記憶した以降の処理は、図１に示す処理と同じであり、受信レベルの大きいものからＣＮＲを測定し、該ＣＮＲが所定のしきい値ＣＮＲthより大きいセルを選択するものであり、各処理ステップに同じステップ番号を付して、その詳細な説明を省略する。

【００６４】次に、図４に示すフローチャートを参照して、本発明の更に他の実施例に係わる移動通信セル判定方法を実施する基地局の処理手順について説明する。図４に示す実施例は、基地局が移動局１０と通信中において該移動局１０が他のセルに移動する場合に移動局１０が次に通信すべきセルを選択する処理を基地局が制御する場合の基地局の処理を示しているものである。この場合には、図３の処理の場合と同様に移動局１０と通信中の基地局は該移動局１０の近傍のセルの拡散符号を通知するようになっているので、移動局１０は基地局から通知された拡散符号についてのみ処理を行えばよい。

【００６５】図４に示す処理においては、まず基地局は通信中の移動局１０に対して近傍のｍ個のセル候補の拡散符号を送信し、移動局１０に記憶させる（ステップ４１０）。そして、この記憶された拡散符号を順次読み出すための変数であるｉを１に設定する（ステップ４２０）。そして、このｉ番目、今の場合には１番目の拡散符号Ｃｉを移動局１０にメモリから読み出させて選択させ、この選択した拡散符号Ｃｉを用いて止まり木チャネルを受信させ、その受信レベルを測定させる（ステップ４３０）。それから、この測定した受信レベルを移動局１０から基地局に送信させ、基地局で受信し、この受信した受信レベルを記憶する（ステップ４４０，４５０）。そして、前記変数ｉが所定の数ｍに等しいか否かをチェックする（ステップ４６０）。変数ｉがｍでない場合には、変数ｉをインクリメントし（ステップ４７０）、ステップ４３０に戻り、メモリに記憶されているすべての拡散符号に対して同様に処理を行う。

【００６６】基地局は、移動局１０から受信し記憶した各セルの受信レベルを大きいものから順に整理し（ステップ４８０）、まず最大の受信レベルのものを選択し（ステップ４９０）、この最大の受信レベルにおける前記ＣＮＲを移動局１０に測定させ、その測定結果を送信させ、基地局で受信する（ステップ５００）。

【００６７】そして、基地局は、この測定したＣＮＲが所定のしきい値ＣＮＲthより大きいか否かをチェックする（ステップ５１０）。このチェックの結果、測定したＣＮＲが所定のしきい値ＣＮＲthよりも小さい場合には、次に受信レベルの大きいものを選択して（ステップ５２０）、ステップ５００に戻り、同様にＣＮＲの測定を行う。

【００６８】ステップ５１０のチェックにおいて、測定したＣＮＲが所定のしきい値ＣＮＲthよりも大きい場合には、当該セルを選択し（ステップ５３０）、基地局は移動局１０にこの選択したセルとの通信を開始させる（ステップ５４０）。

【００６９】次に、図５に示すフローチャートを参照して、本発明の別の実施例に係わる移動通信セル判定方法の処理手順について説明する。なお、図５に示す処理は、図１の処理と同様に、移動局１０が電源を投入した時に、通信すべきセルを選択する処理であり、この場合、移動局１０はサービスエリア内に存在するすべてのセルの拡散符号Ｃを例えばＲＯＭ等に記憶して保持しているものである。

【００７０】図５の処理において、移動局１０の電源が投入されると（ステップ５１０）、まず初期設定が行わ

れ（ステップ５２０）、ＲＯＭに記憶されている拡散符号を順次読み出すための変数であるｉを１に設定する（ステップ５３０）。そして、このｉ番目、今の場合には１番目の拡散符号ＣｉをＲＯＭから読み出す（ステップ５４０）。そして、この拡散符号Ｃｉを用いて止まり木チャネルを受信して、その受信レベルを測定する（ステップ５５０）。

【００７１】それから、この測定された受信レベルを記憶し（ステップ５６０）、前記変数ｉが所定の数ｎに等しいか否かをチェックする（ステップ５７０）。変数ｉがｎでない場合には、変数ｉをインクリメントし（ステップ５８０）、ステップ５４０に戻り、ＲＯＭに記憶されているすべての拡散符号に対して同様の処理を行う。

【００７２】ＲＯＭに記憶されているすべての拡散符号に対して上述した受信レベルの測定および記憶を終了すると、記憶した受信レベルを順次読み出し、所定の受信レベルしきい値より大きいものを選択し（ステップ５９０）、この選択した受信レベルのＣＮＲを測定し記憶する（ステップ６００）。

【００７３】それから、このように測定し記憶したＣＮＲを互いに比較して、最大のＣＮＲのセルを選択し（ステップ６１０）、この選択したセルと通信開始する（ステップ６２０）。

【００７４】なお、図５に示す移動通信セル判定方法の処理手順は、移動局１０を中心にした処理を示しているが、図４の処理と同様に基地局を主とした場合の処理も可能であるが、その図示を省略する。

【００７５】

【発明の効果】以上説明したように、本発明によれば、受信レベルのみでなく、測定した受信レベルの大きいものについてキャリア対雑音比を測定し、このキャリア対雑音比が所定のしきい値より大きいセルを選択したり、または測定した受信レベルが所定のしきい値よりも大きいものにおけるキャリア対雑音比を測定し、このキャリア対雑音比が最大のセルを選択するので、干渉レベルが大きくて受信レベルが大きく見えるにも関わらず通信品質の悪いセルを選択することがなく、通信品質の良好なセルを選択することができる。

【００７６】また、本発明によれば、基地局の制御のもとに移動局に受信レベルを測定させるのみでなく、測定させた受信レベルの大きいものについてキャリア対雑音比を測定させ、このキャリア対雑音比が所定のしきい値より大きいセルを選択したり、または測定させた受信レベルが所定のしきい値よりも大きいものにおけるキャリア対雑音比を測定させ、このキャリア対雑音比が最大のセルを選択するので、干渉レベルが大きくて受信レベルが大きく見えるにも関わらず通信品質の悪いセルを選択することがなく、通信品質の良好なセルを選択することができる上に、基地局の制御によりセル選択を行っているため、移動局における制御、判定、記憶等の処理を基地局が共通的に行うことができ、移動局の構成および処理を簡単化することができる。

【図面の簡単な説明】

【図１】本発明の一実施例に係わる移動通信セル判定方法の処理手順を示すフローチャートである。

【図２】図１の移動通信セル判定方法を実施する移動局および基地局の構成を示すブロック図である。

【図３】本発明の他の実施例に係わる移動通信セル判定方法の処理手順を示すフローチャートである。

【図４】本発明の更に他の実施例に係わる移動通信セル判定方法を実施する基地局の処理手順を示すフローチャートである。

【図５】本発明の別の実施例に係わる移動通信セル判定方法の処理手順を示すフローチャートである。

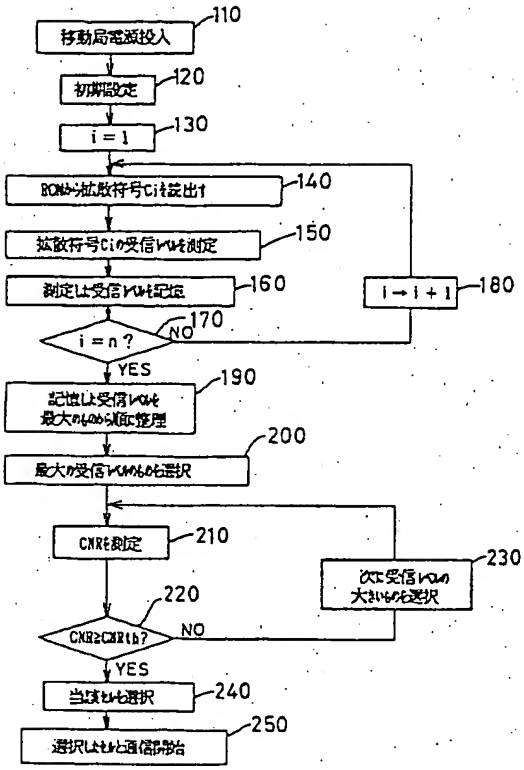
【図６】ＣＤＭＡ方式移動通信システムのサービスエリア内における複数のセルの関係を示す説明図である。

【図７】受信レベルに含まれる干渉レベル等の雑音を示す説明図である。

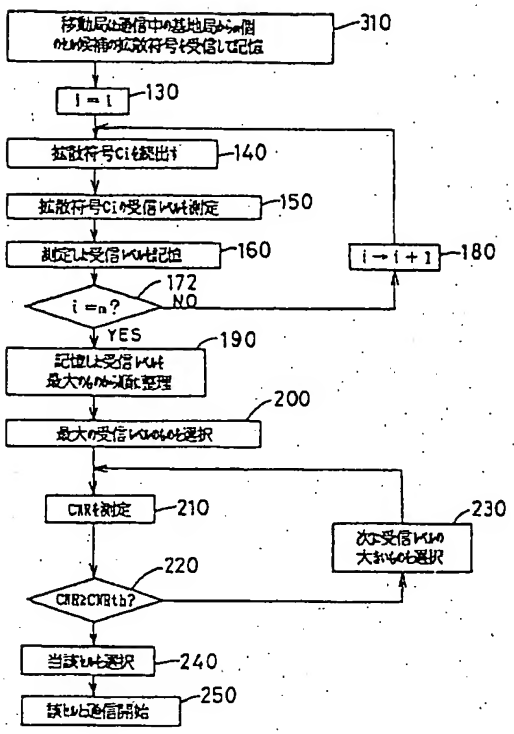
【符号の説明】

１０　移動局
１３　送信回路部
１４　受信回路部
１５　制御部
１６　受信レベル・干渉レベル検出部
１７　相関検出器
１８　レベル検出器
１９　干渉検出器
２０　基地局
２１　アンテナ
２６　基地局増幅器
２７　変復調装置
２８　拡散装置
３０　制御バスコントロール
３１　監視制御装置
３２　２Ｍ／１．５Ｍインタフェース装置
３３　基地局制御装置
３４　タイミング供給装置

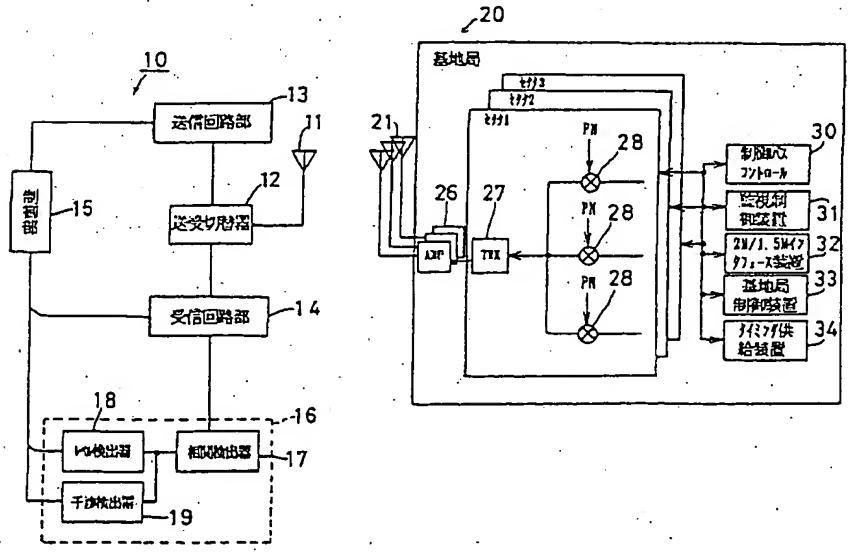
【図１】


移動局電源投入
110
初期設定
120
i＝1
130
ROMから拡散符号Ciを読出す
140
拡散符号Ciの受信レベルを測定
150
測定した受信レベルを記憶
160
i＝n？
170
NO
YES
i→i＋1
180
記憶した受信レベルを最大のものから順に整理
190
最大の受信レベルのものを選択
200
CNRを測定
210
CNR≧CNRth？
220
NO
YES
次に受信レベルの大きいものを選択
230
当該セルを選択
240
選択したセルと通信開始
250

【図３】


移動局は通信中の基地局からの他のセル候補の拡散符号を受信して記憶
310
i＝1
130
拡散符号Ciを読出す
140
拡散符号Ciの受信レベルを測定
150
測定した受信レベルを記憶
160
i→i＋1
180
i＝n？
172
NO
YES
記憶した受信レベルを最大のものから順に整理
190
最大の受信レベルのものを選択
200
CNRを測定
210
次に受信レベルの大きいものを選択
230
CNR≧CNRth？
220
当該セルを選択
240
該セルと通信開始
250

【図２】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送信回路部
13
11
制御部
15
送受切替器
12
受信回路部
14
18
16
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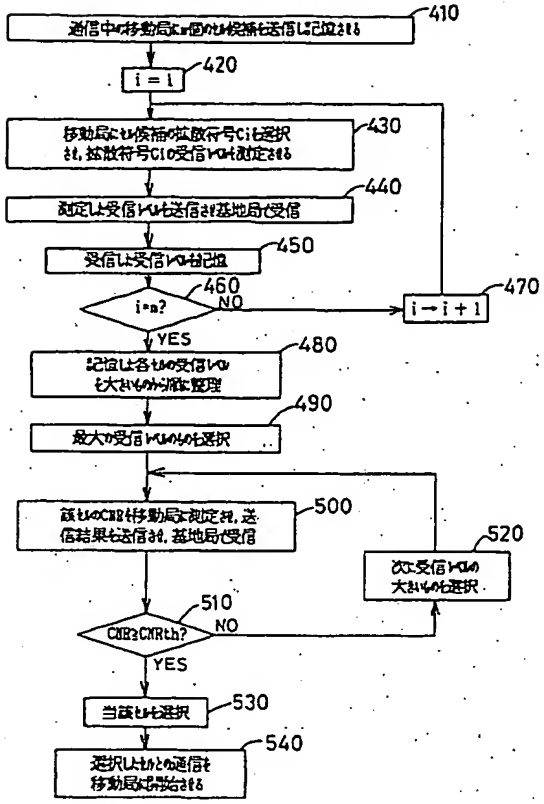
基地局
21
26
27
28
30
31
32
33
34

【図4】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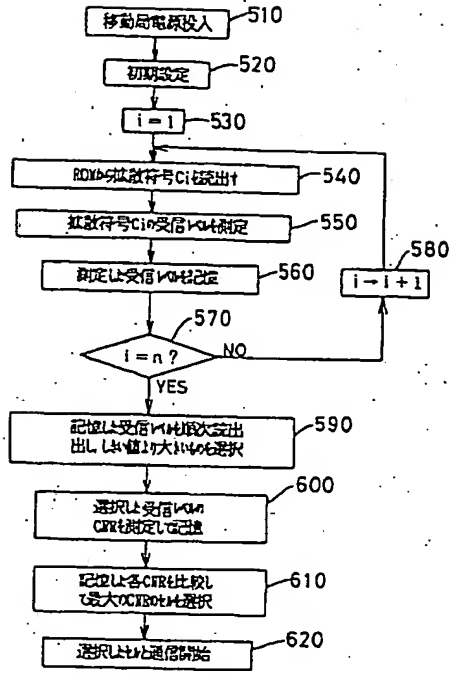
【図5】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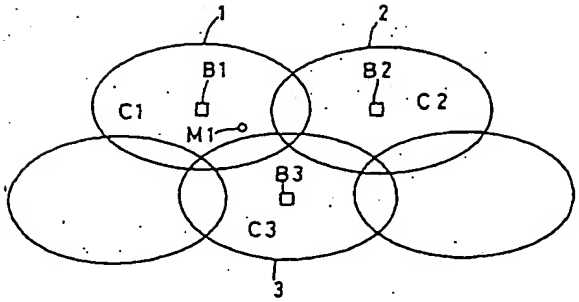
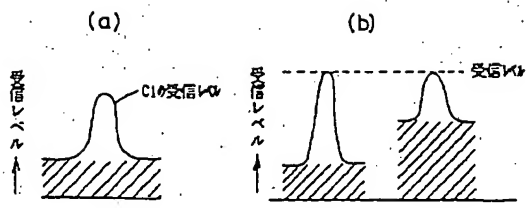

1
2
B1
B2
C1
C2
M1
B3
C3
3

【図７】



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ENGLISH TRANSLATION OF JAPANESE LAID-OPEN PATENT PUBLICATION NO. 7-298336 (filed on April 27, 1994).

[Title of the Invention] MOBILE COMMUNICATION CELL DETERMINATION METHOD, MOBILE STATION APPARATUS, AND BASE STATION APPARATUS

[Claims]

1. A mobile communication cell determination method for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the mobile station holds spreading codes assigned to recommendable cells which the mobile station should communicate with,

the mobile station successively receives perch channels by using the held spreading codes of the recommendable cells, and measures received levels of the perch channels,

the mobile station measures carrier-to-noise ratios of the perch channels in a descending order of the received levels of the perch channels,

and the mobile station selects a cell whose measured carrier-to-noise ratio is larger than a predetermined threshold value.

2. A mobile communication cell determination method for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission

power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the mobile station holds spreading codes assigned to recommendable cells which the mobile station should communicate with,

the mobile station successively receives perch channels by using the held spreading codes of the recommendable cells, and measures received levels of the perch channels,

the mobile station measures crier-to-noise ratios of the perch channels whose measured received levels are higher than a predetermined threshold value,

and the mobile station compares the measured carrier-to-noise ratios with each other, and selects a cell corresponding to the largest carrier-to-noise ratio.

3. The mobile communication cell determination method according to claim 1 or 2, characterized in that the mobile station previously stores the spreading codes of the recommendable cells as spreading codes of all cells.

4. The mobile communication cell determination method according to claim 1 or 2, characterized in that the mobile station receives the spreading codes of the recommendable cells from the base station which the mobile station is communicating with.

5. The mobile communication cell determination method according to claim 1 or 2, characterized in that after the mobile station selects the cell, the mobile station starts to communicate with the selected cell.

6. The mobile communication cell determination method according to claim 1 or 2, characterized in that the mobile station notifies a base station of the selected cell about a fact that the cell is selected, and the notified base

station starts to communicate with the mobile station via a communication channel.

7. A mobile station apparatus for determining a cell which a mobile station in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the mobile station apparatus comprises:

spreading code holding means for holding spreading codes assigned to recommendable cells which the mobile station apparatus should communicate with;

received level measuring means for successively receiving perch channels by using the spreading codes of the recommendable cells held by the spreading code holding means, and measuring received levels of the perch channels,

carrier-to-noise ratio measuring means for measuring carrier-to-noise ratios of the perch channels in descending order of the received levels which are measured by the received level measuring means; and

cell selecting means for selecting a cell whose measured carrier-to-noise ratio is larger than a predetermined threshold value.

8. A mobile station apparatus for determining a cell in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the mobile station apparatus comprises:

spreading code holding means for holding spreading codes assigned to recommendable cells which the mobile station apparatus should communicate with;

received level measuring means for successively receiving perch channels by using the spreading codes of the recommendable cells held by the spreading code holding means, and measuring received levels of the perch channels,

carrier-to-noise ratio measuring means for measuring carrier-to-noise ratios of the perch channels whose received levels measured by the received level measuring means are higher than a predetermined value; and

cell selecting means for comparing the measured carrier-to-noise ratios with each other, and selecting a cell whose carrier-to-noise ratio is largest of the compared carrier-to-noise ratios.

9. The mobile station apparatus according to claim 7 or 8, characterized in that the spreading code holding means further includes spreading code storing means for previously storing the spreading codes assigned to all of the cells.

10. The mobile station apparatus according to claim 7 or 8, characterized in that the spreading code holding means receives the spreading codes of the recommendable cells from the base station which the mobile station apparatus is communicating with, and the spreading code holding means holds the received spreading codes.

11. The mobile station apparatus according to claim 7 or 8, characterized in that the mobile station apparatus further includes communication start means for starting communication with the base station of the cell selected by the cell selecting means.

12. The mobile station apparatus according to claim 7 or 8, characterized in that the mobile station apparatus further includes notifying means for notifying the base station of the cell selected by the cell selecting means about a fact that the call has been selected, and the notified base station starts communication with the mobile station apparatus via a communication channel.

13. A base station apparatus for, during communication with a mobile station, determining a cell which the mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the base station apparatus comprises:

received level receiving means for making the mobile station successively receive perch channels by using spreading codes which are assigned to the recommendable cells and which are held by the mobile station, and making the mobile station measure received levels of the perch channels and transmit a result of the measurement to the base station, and receiving the transmitted result of the measurement;

carrier-to-noise ratio receiving means for making the mobile station measure carrier-to-noise ratios of the perch channels in a descending order of the received levels received by the received level receiving means, making the mobile station transmit the measured carrier-to-noise ratios to the base station, and receiving the transmitted carrier-to-noise ratios; and

selecting means for selecting a cell whose carrier-to-noise ratio received by the carrier-to-noise ratio receiving means is larger than a predetermined threshold value.

14. A base station apparatus for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code,

characterized in that the base station apparatus comprises:

received level receiving means for making the mobile station successively receive perch channels by using spreading codes which are assigned to the recommendable cells and which are held by the mobile station, and making the mobile station measure received levels of the perch channels and transmit a result of the measurement to the base station, and receiving the transmitted result of the measurement;

carrier-to-noise ratio receiving means for making the mobile station measure carrier-to-noise ratios of the perch channels whose received levels received by the received level receiving means are higher than a predetermined threshold value, making the mobile station transmit the measured carrier-to-noise ratios to the base station, and receiving the transmitted carrier-to-noise ratios; and

selecting means for comparing the received carrier-to-noise ratios with each other, and selecting a cell whose carrier-to-noise ratio is largest of the compared carrier-to-noise ratios.

15. The base station apparatus according to claim 13 or 14, characterized in that the mobile station previously stores the spreading codes which are assigned to the recommendable cells and which are held by the mobile station, the spreading codes being stored as spreading codes of all the cells.

16. The base station apparatus according to claim 13 or 14, characterized in that the spreading codes which are assigned to the recommendable cells and which are held by the mobile station are transmitted from the base station to the mobile station, and are held by the mobile station.

17. The base station apparatus according to claim 13 or 14, characterized in that the base station apparatus further includes communication start means for making the mobile station start communication with a base station of the cell selected by the selecting means.

18. The base station apparatus according to claim 13 or 14, characterized in that the base station apparatus further includes notifying means for notifying a base station of the cell selected by the selecting means about a fact that the cell has been selected, and the notified base station starts communication with the mobile station via a communication channel.

[Detailed Description of the Invention]

[0001]

[Field of the invention]

The present invention relates to a mobile communication cell determination method used in a mobile communication system of a code-division multiple access (CDMA) which uses a spectrum spreading code. The present invention further relates to a mobile station apparatus and a base station apparatus which use this method. Specifically, the present invention relates to a mobile communication cell determination method for determining a cell with which a mobile station should communicate in a service area including a plurality of cells in a mobile communication system of the CDMA, and relates to a mobile station apparatus and a base station apparatus which use this method.

[0002]

[Prior Art]

In a mobile communication system of the CDMA which uses the spectrum spreading code, a service area is divided into a plurality of cells each of which is a unit area. One base station is provided in each cell. A mobile station in a cell of the service area communicates with a base station in this cell by using a wireless circuit, and this base station communicates with another mobile station or a telephone by using another wireless circuit or a communication circuit.

[0003]

At the time the mobile station is turned on, the mobile station is in a state in which the mobile station does not communicate with any base station. Accordingly, it is unknown which cell has this mobile station therewithin. In addition, it is unknown which base station the mobile station should communicate with. For this reason, the mobile station need perform a cell determination process in order to determine which cell has the mobile station therewithin and which base station the mobile station can communicate with.

[0004]

In the mobile communication system of the CDMA, predetermined different spreading codes having the same frequency are each assigned to base stations of the respective cells. For example, as shown in Fig. 6, respective different spreading codes C1, C2, C3 ... are assigned to a plurality of cells 1, 2, 3 ... provided in the service area. Each base station B1, B2, B3 ... transmits a perch channel spread by the assigned spreading code, all the time.

[0005]

On the other hand, each base station M1 stores, in a ROM, the spreading codes C1, C2, C3 ... assigned to the respective cells. When the mobile station performs the cell determination at the time the mobile station is turned on, the mobile station reads the spreading codes stored in the ROM, successively, receives the perch channels spread by the read spreading codes,

and compares received signal levels with each other. In this manner, the mobile station selects the cell corresponding to the highest received signal level, and communicates with the base station of the selected cell.

[0006]

Furthermore, such cell selection should be performed at the time the mobile station moves to the current cell to another cell as well as at the time the mobile station is turned on.

[0007]

In the mobile communication method of the CDMA, the same frequency is used in all the cells, and the same frequency is divided by the spreading codes. The divided frequency is used as a carrier. Each cell transmits the perch channel all the time. This perch channel is modulated by the same frequency, and is spread by its own spreading code which has been assigned individually. This perch channel is used for the cell determination. Similarly, usual communication channel uses the spreading code, and the respective spreading codes have correlation with each other. This correlation is added to the received signal level as a noise.

[0008]

The noise added to the received level includes a noise caused by mutual correlation between spreading codes. The spreading codes are different from each other in a cluster including a plurality of cells, but these spreading codes may be used repeatedly in another cluster. Accordingly, the noise includes a noise caused by repeat use of the spreading code, and thermal noise.

[0009]

Fig. 7 shows characteristics in a case where the spreading code undergoes a process of a correlation unit in order to obtain a period by the spreading code C1. As shown in Fig. 7(a), the received level of the spreading code C1 is increased by the noise indicated by the oblique lines, i.e., mutual interference with other spreading codes C2, C3 and the

like.

[0010]

For this reason, as shown in Fig. 7(b), even if the measured received levels are same, communication quality of the selected channel of the right side received level is considerably poor because the noise added to the right side received level is considerably larger than the noise added to the left side received level.

[0011]

In other words, in the above-described conventional manner, the received level which includes the noise such as the interference level is measured, the cell to be selected is determined by taking the only received level into account, and contribution of the noise such as the noise caused by the mutual correlation or the like is ignored. Accordingly, even if the cell whose received level is large, in fact, the noise caused by the considerably large interference level may be added to the received level. Therefore, if the cell is selected only based on the received level, communication quality may be considerably poor.

[0012]

With the view of the foregoing, it is an object of the present invention to provide a mobile communication cell determination method, a mobile station apparatus, and a base station apparatus for selecting a cell whose communication quality is good by taking into account a carrier-to-noise ratio as well as a received level.

[0013]

According to one aspect of the present invention, there is provided a mobile communication cell determination method for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is

modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically, in this method, the mobile station holds spreading codes assigned to recommendable cells which the mobile station should communicate with, the mobile station successively receives perch channels by using the held spreading codes of the recommendable cells, and measures received levels of the perch channels, the mobile station measures a carrier-to-noise ratio of the perch channel in a descending order of the received levels of the perch channels, and the mobile station selects a cell whose measured carrier-to-noise ratio is larger than a predetermined threshold value.

[0014]

According to another aspect of the present invention, there is provided a mobile communication cell determination method for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically, in this method, the mobile station holds spreading codes assigned to recommendable spreading cells which the mobile station should communicate with, the mobile station successively receives perch channels by using the held spreading codes of the recommendable cells, and measures received levels of the perch channels, the mobile station measures crrier-to-noise ratios of the perch channels whose measured received levels are higher than a predetermined threshold value, and the mobile station compares the measured carrier-to-noise ratios with each other, and selects a cell corresponding to the largest carrier-to-noise ratio.

[0015]

According to another aspect of the present

invention, in the mobile communication cell determination method, the mobile station previously stores the spreading codes of the recommendable cells as spreading codes of all cells.

[0016]

According to another aspect of the present invention, in the mobile communication cell determination method, the mobile station receives the spreading codes of the recommendable cells from the base station which the mobile station is communicating with.

[0017]

According to another aspect of the present invention, in the mobile communication cell determination method, after the mobile station selects the cell, the mobile station starts to communicate with the selected cell.

[0018]

According to another aspect of the present invention, in the mobile communication cell determination method, the mobile station notifies a base station of the selected cell about a fact that the cell is selected, and the notified base station starts to communicate with the mobile station via a communication channel.

[0019]

According to another aspect of the present invention, there is provided a mobile station apparatus for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically the mobile station apparatus comprises:

spreading code holding means for holding spreading codes assigned to recommendable cells which the mobile station

apparatus should communicate with;

received level measuring means for successively receiving perch channels by using the spreading codes of the recommendable cells held by the spreading code holding means, and measuring received levels of the perch channels; and

carrier-to-noise ratio measuring means for measuring carrier-to-noise ratios of the perch channels in descending order of the received levels which are measured by the received level measuring means;

cell selecting means for selecting a cell whose measured carrier-to-noise ratio is larger than a predetermined threshold value.

[0020]

According to another aspect of the present invention, there is provided a mobile station apparatus for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically, the mobile station apparatus comprises:

spreading code holding means for holding spreading codes assigned to recommendable cells which the mobile station apparatus should communicate with;

received level measuring means for successively receiving perch channels by using the spreading codes of the recommendable cells held by the spreading code holding means, and measuring received levels of the perch channels,

carrier-to-noise ratio measuring means for measuring carrier-to-noise ratios of the perch channels whose received level measured by the received level measuring means are higher than a predetermined value; and

cell selecting means for comparing the measured

carrier-to-noise ratios with each other, and selecting a cell whose carrier-to-noise ratio is largest of the compared carrier-to-noise ratios.

[0021]

According to another aspect of the present invention, in the mobile station apparatus, the spreading code holding means further includes spreading code storing means for previously storing the spreading codes assigned to all of the cells.

[0022]

According to another aspect of the present invention, in the mobile station apparatus, the spreading code holding means receives the spreading codes of the recommendable cells from the base station which the mobile station apparatus is communicating with, and the spreading code holding means holds the received spreading codes.

[0023]

According to another aspect of the present invention, the mobile station apparatus further includes communication start means for starting communication with the base station of the cell selected by the cell selecting means.

[0024]

According to another aspect of the present invention, the mobile station apparatus further includes notifying means for notifying the base station of the cell selected by the cell selecting means about a fact that the call has been selected, and the notified base station starts communication with the mobile station apparatus via a communication channel.

[0025]

According to another aspect of the present invention, there is provided a base station apparatus for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch

channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically, the base station apparatus includes:

received level receiving means for making the mobile station successively receive perch channels by using spreading codes which are assigned to the recommendable cells and which are held by the mobile station, and making the mobile station measure received levels of the perch channels and transmit a result of the measurement to the base station, and receiving the transmitted result of the measurement;

carrier-to-noise ratio receiving means for making the mobile station measure carrier-to-noise ratios of the perch channels in a descending order of the received levels received by the received level receiving means, making the mobile station transmit the measured carrier-to-noise ratios to the base station, and receiving the transmitted carrier-to-noise ratios; and

selecting means for selecting a cell whose carrier-to-noise ratio received by the carrier-to-noise ratio receiving means is larger than a predetermined threshold value.

[0026]

According to another aspect of the present invention, there is provided a base station apparatus for determining a cell which a mobile station should communicate with in a mobile communication system of a code-division multiple access manner in which a base station is provided in each of a plurality of cells, each base station transmits a perch channel all the time at constant transmission power which is not controlled, and the perch channel is modulated by a same frequency, and is spread by an individually assigned its own spreading code. Specifically, the base station apparatus includes:

received level receiving means for making the mobile station successively receive perch channels by using

spreading codes which are assigned to the recommendable cells and which are held by the mobile station, and making the mobile station measure received levels of the perch channels and transmit a result of the measurement to the base station, and receiving the transmitted result of the measurement;

carrier-to-noise ratio receiving means for making the mobile station measure carrier-to-noise ratios of the perch channels whose received levels received by the received level receiving means are higher than a predetermined threshold value, making the mobile station transmit the measured carrier-to-noise ratios to the base station, and receiving the transmitted carrier-to-noise ratios; and

selecting means for comparing the received carrier-to-noise ratios with each other, and selecting a cell whose carrier-to-noise ratio is largest of the compared carrier-to-noise ratios.

[0027]

According to another aspect of the present invention, in the base station apparatus, the mobile station previously stores the spreading codes which are assigned to the recommendable cells and which are held by the mobile station, the spreading codes being stored as spreading codes of all the cells.

[0028]

According to another aspect of the present invention, in the base station apparatus, the spreading codes which are assigned to the recommendable cells and which are held by the mobile station are transmitted from the base station to the mobile station, and are held by the mobile station.

[0029]

According to another aspect of the present invention, the base station apparatus further includes communication start means for making the mobile station start communication with a base station of the cell selected by the selecting means.

[0030]

According to another aspect of the present invention, the base station apparatus further includes notifying means for notifying a base station of the cell selected by the selecting means about a fact that the cell has been selected, and the notified base station starts communication with the mobile station via a communication channel.

[0031]

[Effect]

In the mobile communication cell determination method according to the present invention, the mobile station successively measures received levels of the perch channels by using spreading codes assigned to the recommendable cells which the mobile station should communicate with. The mobile station measures carrier-to-noise ratios of the perch channels in a descending order of the received levels. Next, the mobile station selects a cell whose carrier-to-noise ratio is larger than a predetermined threshold value.

[0032]

In the mobile communication cell determination method according to the present invention, the mobile station successively measures received levels of the perch channels by using spreading codes assigned to the recommendable cells which the mobile station should communicate with. The mobile station measures carrier-to-noise ratios whose received levels are higher than a predetermined threshold value. Next, the mobile station selects a cell whose carrier-to-noise ratio is the highest.

[0033]

In the mobile communication cell determination method according to the present invention, the mobile station previously stores the spreading codes of all the cells.

[0034]

In the mobile communication cell determination method according to the present invention, the mobile station receives the spreading codes of the recommendable cells from

the base station which the mobile station is communicating with.

[0035]

In the mobile communication cell determination method according to the present invention, after the mobile station selects the cell, the mobile station starts communication with the selected cell.

[0036]

In the mobile communication cell determination method according to the present invention, the mobile station notifies a base station of the selected cell about a fact that the cell is selected. The notified base station starts to communicate with the mobile station via a communication path.

[0037]

In the mobile station apparatus according to the present invention, the mobile station successively measures the received levels of the perch channels by using the spreading codes assigned to the recommendable cells which the mobile station should communicate with. The mobile station apparatus measures the carrier-to-noise ratios of the perch channels in a descending order of the received levels. Next, the mobile station apparatus selects a cell whose carrier-to-noise ratio is larger than a predetermined value.

[0038]

In the mobile station apparatus according to the present invention, the mobile station successively measures the received levels of the perch channels by using the spreading codes assigned to the recommendable cells which the mobile station should communicate with. The mobile station apparatus measures the carrier-to-noise ratios of the perch channels whose received levels are higher than a predetermined threshold value. Next, the mobile station apparatus selects a cell whose carrier-to-noise ratio is the highest.

[0039]

In the mobile station apparatus according to the present invention, the mobile station apparatus previously stores the spreading codes assigned to all the cells.

[0040]

In the mobile station apparatus according to the present invention, the mobile station apparatus receives the spreading codes of the recommendable cells from a base station which the mobile station apparatus is communicating with.

[0041]

In the mobile station apparatus according to the present invention, the mobile station apparatus further includes communication start means for starting communication with the base station of the selected cell.

[0042]

In the mobile station apparatus according to the present invention, the mobile station apparatus further includes notifying means for notifying a base station of the selected cell about a fact that the cell is selected. The notified base station starts to communicate with the mobile station via a communication channel.

[0043]

In the base station apparatus according to the present invention, the base station apparatus makes the mobile station successively measures the received levels of the perch channels by using the spreading codes assigned to the recommendable cells. The base station apparatus receives a result of the measurement, and makes the mobile station measures the carrier-to-noise ratios of the perch channels in a descending order of the received levels. The base station apparatus receives the measured carrier-to-noise ratios from the mobile station, and selects a cell whose carrier-to-noise ratio is larger than a predetermined value.

[0044]

In the base station apparatus according to the present invention, the base station apparatus makes the mobile station successively measures the received levels of the perch channels by using the spreading codes assigned to the recommendable cells. The base station apparatus receives a result of the measurement from the mobile station, and makes

the mobile station measure carrier-to-noise ratios of the perch channels whose received levels are higher than a predetermined threshold value, and receives measured carrier-to-noise ratios from the mobile station. Next, the base station apparatus selects a cell whose carrier-to-noise ratio is the largest.

[0045]

In the base station apparatus according to the present invention, the spreading codes of all the cells are previously stored in the mobile station.

[0046]

In the base station apparatus according to the present invention, the spreading codes assigned to the recommendable cells are transmitted from the base station apparatus to the mobile station, and are held by the mobile station.

[0047]

In the base station apparatus according to the present invention, the base station apparatus makes the mobile station start to communicate with a base station of the selected cell.

[0048]

In the base station apparatus according to the present invention, the base station apparatus includes notifying means for notifying a base station of the selected cell about a fact that the cell is selected. The notified base station starts to communicate with the mobile station via a communication channel.

[0049]

[Embodiment]

An embodiment of the present invention will be described with reference to the drawings. Fig. 1 is a flow chart showing a process procedure for a mobile communication cell determination method according to the embodiment of the present invention. In the mobile communication cell determination method shown in Fig. 1, the mobile station determines a cell with which the mobile station should communicate, in a mobile

communication system of the CDMA which uses the spectrum spreading code. This cell determination process is necessary, for example, when the mobile station is turned on. In addition, in order to select a cell, this cell determination process is necessary when the mobile station moves to another cell from a cell in which the mobile station is communicating with the base station.

[0050]

In the mobile communication cell determination method of this embodiment, in order to select cell to communicate with, a received level of a perch channel is measured. The perch channel is transmitted from the base station of each cell all the time. The perch channel is modulated by the same frequency, and is spread by an individually assigned spreading code. Further, transmission power for the perch channel is constant, and is not controlled. In addition to a condition of a cell having a large received level, as described above with reference to Fig. 7, the received level of the perch channel received from each cell is increased by adding a noise of mutual interference. Accordingly, by taking into account the noise of the mutual interference (specifically, the noise of the mutual interference by other spreading codes), a noise caused by repeat use of its own spreading code, a thermal noise, and the like, a ratio of this noise to the carrier, i.e., a carrier-to-noise ratio (CNR) is also calculated. A cell whose CNR is larger than a predetermined value is selected.

[0051]

In this manner, by taking into account the CNR as well as the received level, as shown in Fig. 7(b), a left cell having a smaller noise (indicated by oblique lines) caused by the mutual interference is selected from left and right cells even if the right and left cells have the same received level. In other words, a CNR of the left cell having a smaller noise (indicated by the oblique lines) caused by the mutual interference is larger than a CNR of the right cell, so that

the cell of the left side signal is selected.

[0052]

Fig. 2 is a block diagram showing configuration of a mobile station 10 and a base station 20 which implement the mobile communication cell determination method of Fig. 1. The mobile station 10 includes an antenna 11 for communicating with the base station 20. The mobile station 10 further includes a transmission circuit unit 13 and a reception circuit unit 14 which are connected to the antenna via a transmission/reception switching unit 12, and includes a control unit connected to the transmission circuit unit 13 and the reception circuit unit 14. The mobile station further includes a reception level/interference level detection unit 16 for detecting a received level of the perch channel received by the reception circuit unit 14, and detecting interference level corresponding to a noise caused by the mutual interference included in the received level. The control unit 15 calculates the CNR based on the received level and the interference level detected by the received level/interference level detection unit 16.

[0053]

The received level/interference level detection unit 16 includes a correlation detection unit 17, a level detection unit 18, and an interference detection unit 19. The reception circuit unit 14 receives the perch channel transmitted from the base stations of the respective cells, via the antenna 11 and the transmission/reception switching unit 14, and an output signal from the reception circuit unit 14 is provided to the correlation detection unit 17. The correlation detection unit 17 successively performs correlation detection with a level monitoring spreading code for monitoring a level of the perch channel indicated by the control unit 15. The correlation detection unit 17 performs inverse despreading of this output signal from the reception circuit unit 14, by using the corresponding level monitoring spreading code at a timing obtained at the correlation detection unit 17. A power spectrum obtained by the despreading is provided to the level detection

unit 18 and the interference detection unit 19 where the received level and the interference level are measured, respectively. The obtained received level and interference level are provided to the control unit 15 where the CNR is calculated from the received level and the interference level. The CNR is used for a process in the flow chart of Fig. 1, as described later. The optimum cell is selected based on the CNR.

[0054]

In the base station shown in Fig. 1, a base station amplifier connected to an antenna 21 for communicating with the mobile station is connected to a modulation/demodulation unit 27. The modulation/demodulation unit 27 is connected to a spreading unit 28. A control bus control 30, a monitoring control unit 31, a 2M/1.5M interface unit 32, a base station control unit 32, and a timing providing unit 34 are connected to the modulation/demodulation unit 27.

[0055]

Control data for the perch channel generated in the base station 20 having such configuration are spread by the level monitoring spreading code at the spreading unit 28. Further spread control data are added to a transmission signal by the modulation/demodulation unit 27. A modulated output signal from the modulation/demodulation unit 27 is amplified by the base station amplifier 26, and is transmitted from the antenna 21 as a radio wave. In Fig. 2, only circuit units for transmission are shown in the base station 21, and circuit units for reception are not shown because the circuit units for reception are usually known.

[0056]

Next, a process of the mobile communication cell determination method will be described with reference to the flow chart of Fig. 1. The process of Fig. 1 is a process performed when the mobile station 10 is turned on. In this case, the mobile station 10 stores in a ROM or the like spreading codes C of all cells of the service area.

[0057]

In the process of Fig. 1, when the mobile station 10 is turned on at a step 110, initial setting is performed at a step 120. At a step 130, a variable "i" for successively reading the spreading codes stored in the ROM is set to be "1". Subsequently, at a step 140, the spreading code Ci of the order i (in this case, the order 1) is read from the ROM. Next, at a step 150, the mobile station 10 receives the perch channel by using this spreading code Ci, and measures the received level. Specifically, the spreading code of the perch channel from the base station is despread by the read spreading code, and the received level is measured.

[0058]

Then, the measured received level is stored at a step 160. At a step 170, it is determined whether or not the variable "i" is equal to a predetermined number "n". If the variable "i" is not the predetermined number "n", the variable "i" is incremented at a step 180, and the procedure returns to the step 140. After that, the same process is performed for all the spreading codes stored in the ROM.

[0059]

When the measurement and storage of the received level are performed for all the spreading codes stored in the ROM, the highest received level is selected at a step 209. At a step 210, the CNR of this highest received level is measured. At a step 220, it is determined whether or not the measured CNR is larger than a predetermined threshold value CNRth. If it is determined that the measured CNR is smaller than the CNRth, the second highest received level is selected at a step 230. Then, the procedure returns to the step 210, and a CNR is measured in the same manner.

[0060]

If at the step 220, it is determined that the measured CNR is larger than the predetermined threshold value CNRth, the corresponding cell is selected at a step 240. The mobile station 10 start to communicate with this selected cell at a step 250.

[0061]

Next, a process procedure of the mobile station cell determination method according to another embodiment of the present invention will be described with reference to a flow chart of Fig. 3. In this example shown in Fig. 3, a cell determination process is performed when the mobile station 10 moves to another cell during communication with the base station, and selects a next cell which this mobile station should communicate with. In this case, the mobile station 10 is notified about the spreading codes of the near cells by the base station which the mobile station is currently communicating with. Accordingly, differently from the example of Fig. 1, the mobile station 10 need not perform the process for all the spreading codes stored in the ROM, and it is sufficient that the mobile station 10 performs the process only for the spreading codes notified by the base station.

[0062]

In the process shown in Fig. 3, at a step 310, the mobile station 10 receives "m" number of spreading codes of the near-located recommendable cells, from the base station which the mobile station 10 is currently communicating with. The mobile station 10 stores the "m" received recommendable spreading codes in a memory. Then, at a step 130, a variable "i" for successively reading these stored spreading codes is set to be "1". At a step 140, a spreading code Ci whose order is "1" (in this case, the order is "1") is read from the memory. At a step 150, the perch channel is received by using this spreading code Ci, and the received level of the perch channel is measured. Subsequently, this measured received level is stored, and at a step 172, it is determined whether or not the variable "i" is equal to the predetermined number "m". If the variable "i" is not the number "m", the variable "i" is incremented at a step 180, and the procedure returns to the step 140. Then, the same procedure is performed for all the spreading codes stored in the memory.

[0063]

As described above, the received levels are measured with respect to all the spreading codes which have been notified by the base station and been stored in the memory. The process after storing the recommended spreading codes is the same as that of Fig. 1. The CNR is measured in a descending order in terms of the received level. A cell whose CNR is larger than a predetermined threshold value CNRth is selected. In Fig. 3, the same reference numbers as those of Fig. 1 are attached at steps of Fig. 3, and a detailed description of the process after storing the spreading codes is omitted.

[0064]

A process procedure in the base station which implements a mobile communication cell determination method according to another embodiment of the present invention will be described with reference to a flow chart of Fig. 4. A process of an example shown in Fig. 4 may be applied to a case where when the mobile station 10 moves to another cell during communication with the base station, the base station controls a process for selecting a next cell which the mobile station 10 should communicate with. This process of Fig. 4 is performed at the base station. Similarly to the process of Fig. 3, the base station which is currently communicating with the mobile station 10 notifies the mobile station of the spreading codes of the cells near the mobile station 10. Accordingly, it is sufficient that the mobile station 10 performs the process only for the spreading codes notified by the base station.

[0065]

In the process shown in Fig. 4, at a step 410, the base station transmits "m" near recommendable spreading codes to the mobile station which the base station is currently communicating with, and the mobile station 10 stores the "m" recommendable spreading codes. At a step 420, a variable "i" for successively reading these stored spreading codes is set to be "1". Then, at a step 430, the base station causes the mobile station 10 to read the spreading codes Ci whose order is "i" (in this case, the order is "1"), select it, receive the

perch channel by using this selected spreading code Ci, and measure the received level of the perch channel. At steps 440 and 450, the base station causes the mobile station 10 to transmit the measured received level to the base station, and the base station stores this received level. Subsequently, at a step 460, the base station determines whether or not the variable "i" is equal to a predetermined number "m". If the variable "i" is not "m", the base station increments the variable "i" at a step 470, and the procedure returns to the step 430. After that, the same process is performed for all the spreading codes stored in the memory.

[0066]

At a step 480, the base station arranges, in a descending order in terms of the received level, the received levels of the respective cells which have been received from the mobile station and been stored. At a step 490, first, the base station selects the highest received level. At a step 500, the base station causes the mobile station 10 to measure the CNR of this highest received level, and transmit a result of the measurement to the base station, and the base station receives the result of the measurement.

[0067]

The base station determines whether or not the measured CNR is larger than a predetermined threshold value CNRth at a step 510. If it is determined that the measured CNR is smaller than the predetermined threshold value CNRth, the second highest received level is selected at a step 520, and the procedure returns to the step 500. After that the CNR is measured in the same manner.

[0068]

If at the step 510, it is determined that the measured CNR is larger than the predetermined value CNRth, the base station selects the cell corresponding to this measured CNR at a step 530. At a step 540, the base station causes the mobile station 10 to start to communicate with this selected cell.

[0069]

A process procedure in a mobile communication cell determination method according to another embodiment of the present invention will be described with reference to a flow chart of Fig. 5. Similarly to the process of Fig. 1, the precess shown in Fig. 5 may be applied to a case where the mobile station 10 is turned on, and a cell which the mobile station 10 should communicate with. In this case, the mobile station 10 stores spreading codes C of all the cells in a service area, in a ROM, for example.

[0070]

In the process of Fig. 5, when the mobile station 10 is turned on at a step 510, initial setting is made at a step 520. At a step 530, a variable "i" for successively reading spreading codes stored in the ROM is set to be "1". Then, at a step 550, the spreading code Ci whose order is "i" (in this case, the order is "1") is read from the ROM. At a step 550, the mobile station receives the perch channel by using this spreading code Ci, and measures the received level of the perch channel.

[0071]

Subsequently, the mobile station stores the measured received level at a step 560, and determines whether or not the variable "i" is equal to a predetermined number "n" at a step 570. If the variable "i" is not the number "n", the variable "i" is incremented at a step 580, and the procedure returns to the step 540. After that, the same process is performed for all the spreading codes stored in the ROM.

[0072]

When the measurement and the storage of the received levels are performed for all the spreading codes stored in the ROM, the stored received levels are successively read, and the received levels which are higher than a predetermined received level threshold value are selected at a step 590. At a step 600, the CNRs of these selected received level are measured and stored.

[0073]

Then, these CNRs which have been measured and stored in this manner are compared with each other, and a cell corresponding to the largest CNR is selected at a step 610. At a step 620, the mobile station starts to communicate with this selected cell.

[0074]

The process procedure shown in Fig. 5 for the mobile communication cell determination method is performed mainly from the mobile station 10. However, similarly to the process shown in Fig. 4, the process procedure of Fig. 5 can be performed mainly from the base station, and this procedure is not shown in the drawings.

[0075]

[Advantages of the Invention]

As described above, according to the present invention, not only the received level but also the CNR of the large received level out of the measured received levels are measured. In one example, the cell whose CNR is larger than the predetermined value is selected. In another example, the CNRs whose measured received levels are larger than the predetermined threshold value are measured. Since the cell corresponding to the largest CNR is selected, it is possible to select a cell having good communication quality and to prevent selecting of a cell which has inferior communication quality even when the received level is large due to the large interference level.

[0076]

According to the present invention, under control of the base station, the mobile station measures the received level. Furthermore, the base station performs control such that the mobile station measures the CNRs of the measured large received levels. The cell whose CNR is larger than the predetermined threshold value may be selected. Alternatively, the base station causes the mobile station to measure the CNRs of the measured received levels which are larger than the

predetermined threshold value, and the cell corresponding to the largest CNR of these measured CNR is selected. Accordingly, it is possible to prevent selecting of the cell having inferior communication quality even if the received level is large due to the large interference in this cell. Therefore, it is possible to select the cell having good communication quality. In addition, since the cell is selected under control of the base station, the base station can perform the process in common for control, determination, and storing which are performed at the mobile stations. As a result, configuration and the process of the mobile station can be simplified.

[Brief Description of the Drawings]

[Fig. 1]

A flow chart showing a process procedure for a mobile communication cell determination method according to one embodiment of the present invention.

[Fig. 2]

A block diagram showing configuration of a mobile station and a base station which implement the mobile communication cell determination method of Fig. 1.

[Fig. 3]

A flow chart showing a process procedure for a mobile communication cell determination method according to another embodiment of the present invention.

[Fig. 4]

A flow chart showing a process procedure of a base station which implements a mobile communication cell determination method according to another embodiment of the present invention.

[Fig. 5]

A flow chart showing a process procedure for a mobile communication cell determination according to another embodiment of the present invention.

[fig. 6]

An illustration showing relation among a plurality of cells in a service area of a CDMA mobile communication system.

[Fig. 7]

An illustration showing noises such as an interference level included in a received level.

[Description of the Reference Numbers]

10	a mobile station
13	a transmission circuit unit
14	a reception circuit unit
15	a control unit
16	a received level/interference level detection unit
17	a correlation detection unit
18	a level detection unit
19	an interference detection unit
20	a base station
21	an antenna
26	a base station amplifier
27	a modulation/demodulation unit
28	a spreading unit
30	a control bus control unit
31	a monitoring control unit
32	a 2M/1.5M interface unit
33	a base station control unit
34	a timing providing unit

[Abstract]

[Object]

It is an object of the present invention to provide a mobile communication cell determination method, a mobile station apparatus, and a base station apparatus for selecting a cell whose communication quality is good by taking into account a carrier-to-noise ratio as well as a received level.

[Structure]

A mobile station successively measures received levels of perch channels by using spreading codes assigned to recommendable cells which the mobile station should communicate with (step 150). The mobile station measures carrier-to-noise ratios of the perch channels in a descending order of the received levels (step 210), and compares these carrier-to-noise ratios CNRs with a predetermined threshold value CNRth (step 220). The mobile station selects a cell whose CNR is larger than the CNRth (step 240).

Translation in the drawings.

In Fig. 1.

110 a mobile station is turned on.

120 initial setting

140 a spreading code is read from a ROM

160 a measured received level is stored

190 stored received levels are arranged in a descending order of received levels

200 the received levels are selected in a descending order of received levels.

210 CNR is measured.

230 the next received level is selected

240 a cell is selected

250 communication with the selected cell is started.

In Fig. 2.

15 a control unit

13 a transmission circuit unit

12 a transmission/reception switching unit

14 a reception circuit unit

18 level detection unit

17 a correlation detection unit

19 an interference detection unit

30 a control bus control unit

31 a monitoring control unit

32 a 2M/1.5M interface unit

33 a base station control unit

34 a timing providing unit

In Fig. 3.

310 a mobile station receives "m" spreading codes of recommendable cells from a base station which the mobile station is communicating with, and stores them.

140 a spreading code Ci is read.

150 a received level of the spreading code Ci is

measured.

160 the measured received level is stored.

190 the stored received levels are arranged in a descending order of received levels.

200 the received levels are selected in a descending order of received levels.

210 CNR is measured.

230 the next received level is selected.

240 a cell is selected.

250 communication with the selected cell is started.

In Fig. 4.

410 a mobile station which is communicating with a base station is made to store transmitted "m" recommendable cells.

430 the mobile station is made to select a recommendable spreading code Ci and measure a received level of the selected spreading code Ci.

440 the base station makes the mobile station transmit the measured received level, and receives it.

450 the base station stores the received level.

480 the base station arranges the stored received levels in a descending order of received levels.

490 the received levels are selected in a descending ordr of the received levels.

500 the base station makes the mobile station measure CNR of the cell and transmit a result of the measurement, and receives it.

520 a next received level is selected.

530 the cell is selected.

540 the base station makes the mobile station start to communicate with the selected cell.

In Fig. 5.

510 a base station is turned on.

520 initial setting

540 a spreading code Ci is read from a ROM.

550 a received level of the spreading code Ci is measured.

560 the measured received level is stored.

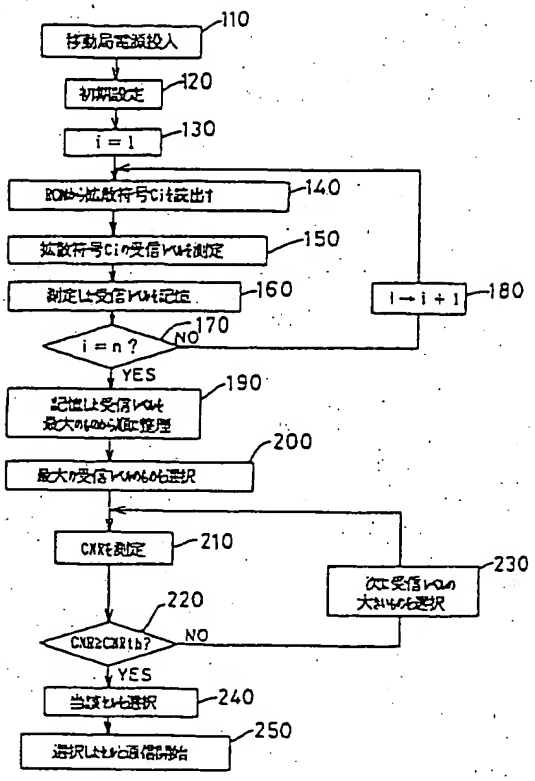
590 the stored received levels are successively read, and the received levels which are higher than a threshold value are selected.

600 CNRs of the selected received levels are measured and stored.

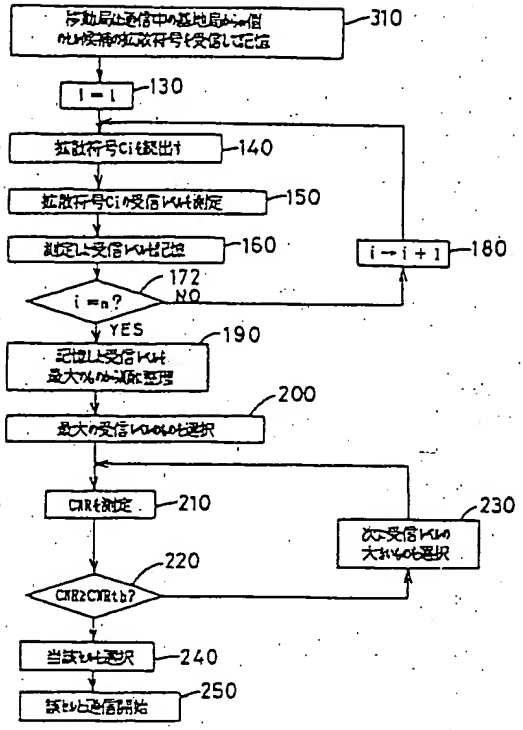
610 the stored CNRs are compared with each other, and a cell of the largest CNR is selected.

620 communication with the selected cell is started.

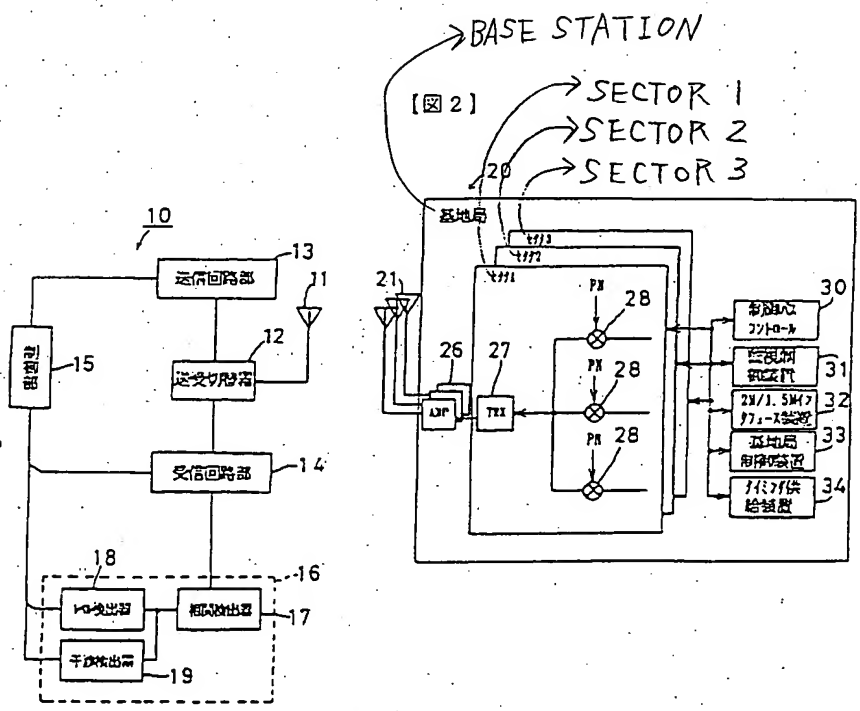
【図1】

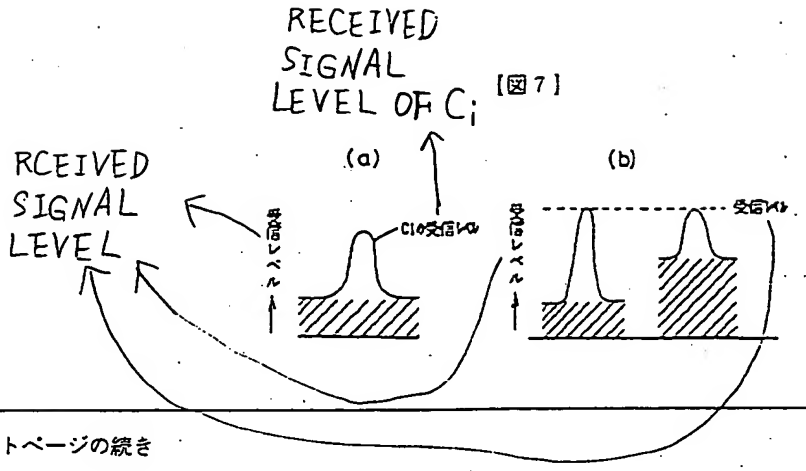

移動局電源投入
110
初期設定
120
i＝1
130
ROMから拡散符号Ciを読出す
140
拡散符号Ciの受信レベルを測定
150
測定した受信レベルを記憶
160
i＝n？
170
NO
YES
i→i＋1
180
記憶した受信レベルを最大のものから順に整理
190
最大の受信レベルのものを選択
200
CNRを測定
210
CNR≧CNRth？
220
NO
YES
次に受信レベルの大きいものを選択
230
当該セルを選択
240
選択したセルと通信開始
250

【図3】


移動局は通信中の基地局からの信号および待受中の拡散符号を受信して記憶
310
i＝1
130
拡散符号Ciを読出す
140
拡散符号Ciの受信レベルを測定
150
測定した受信レベルを記憶
160
i→i＋1
180
i＝n？
172
NO
YES
記憶した受信レベルを最大のものから順に整理
190
最大の受信レベルのものを選択
200
CNRを測定
210
次に受信レベルの大きいものを選択
230
CNR≧CNRth？
220
当該セルを選択
240
該セルと通信開始
250

【図2】


BASE STATION
SECTOR 1
SECTOR 2
SECTOR 3
20
基地局
10
送信回路部
13
11
送受切換器
12
受信回路部
14
15
18
16
17
19
21
26
27
28
PN
30
31
32
33
34



【図7】

フロントページの続き

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H04J 13/00					
			H04B 7/26	113 Z	
			H04J 13/00	A	

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